

Geothermal Heat Exchange Well Standards Update Initial Stakeholder Meeting

November 30, 2012

Department of Water Resources

Introduction

- Project Team
- Current Project: Update GHEW Standards
- Stakeholder Participation

Outreach to Potential Partners

California Groundwater Association

CaliforniaGeo

California Conference of Directors of Environmental Health

CCDEH Water Well Technical Advisory Committee

C57 Licensees/State Contractors License Board

Groundwater Resources Association of California

Association of Groundwater Agencies

American Ground Water Trust

Geothermal Exchange Organization

California Geothermal Energy Collaborative, UC Davis

International Ground Source Heat Pump Association

National Groundwater Association

Association of Environmental and Engineering Geologists

USGS, California Water Science Center

Department of Pesticide Regulation

State Water Resources Control Board

Regional Water Quality Control Boards

Department of Public Health

Public Utilities Commission

California Energy Commission

Department of Toxic Substances Control

California State Association of Counties

League of California Cities

County Engineers Association of California

Association of California Water Agencies

Department of Transportation Geotechnical Services

The Groundwater Foundation

CASGEM listserv

IRWM Grants listserv

DWR (internal)

Meeting Overview

- Recorded Meeting
- Sign-In Sheet
- Ground Rules:
 - Cell phone courtesy
 - No side conversations
 - Be respectful of others
 - Questions held to end

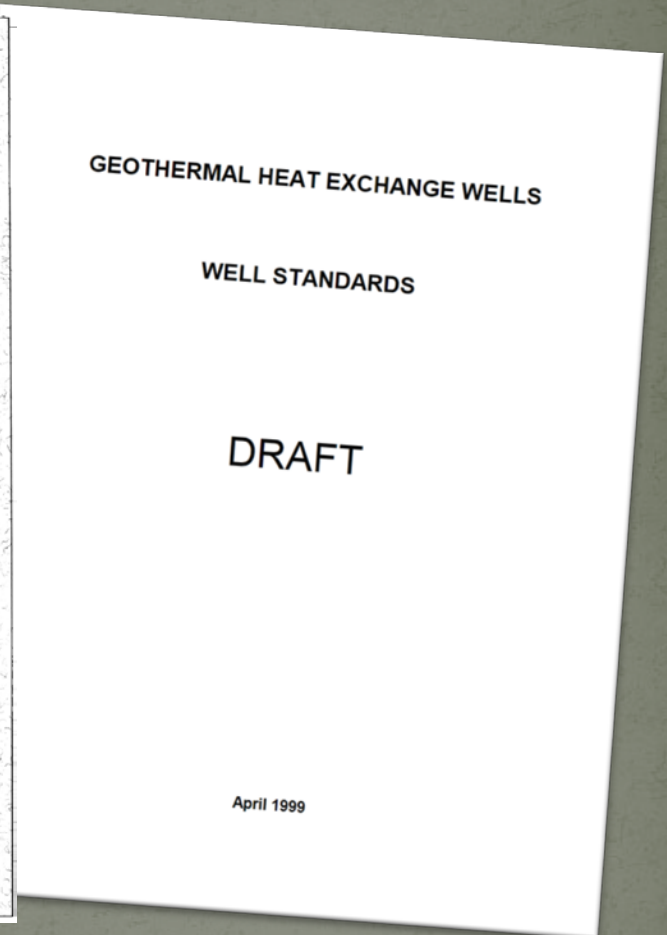
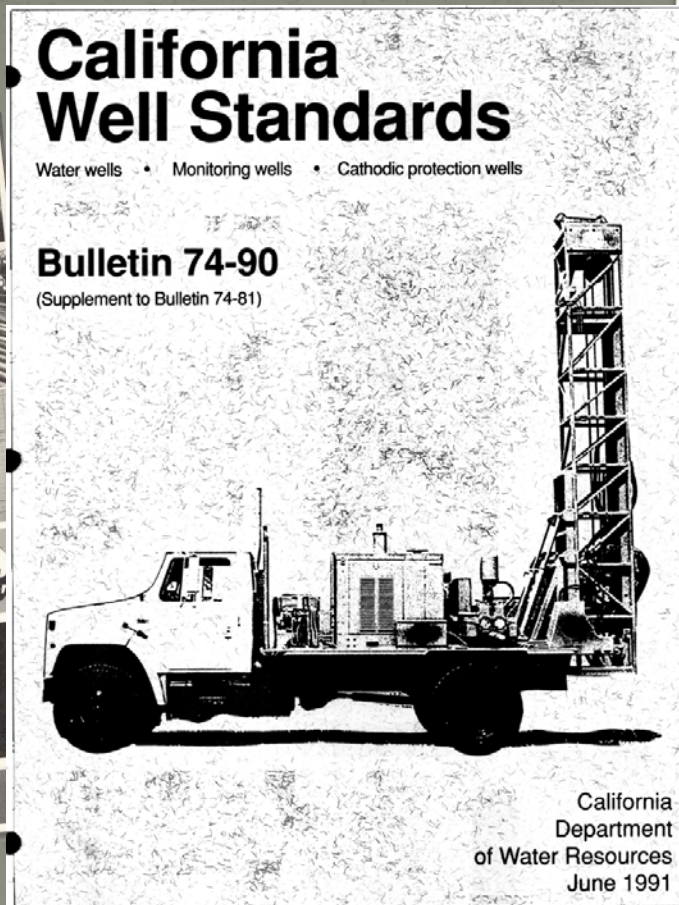
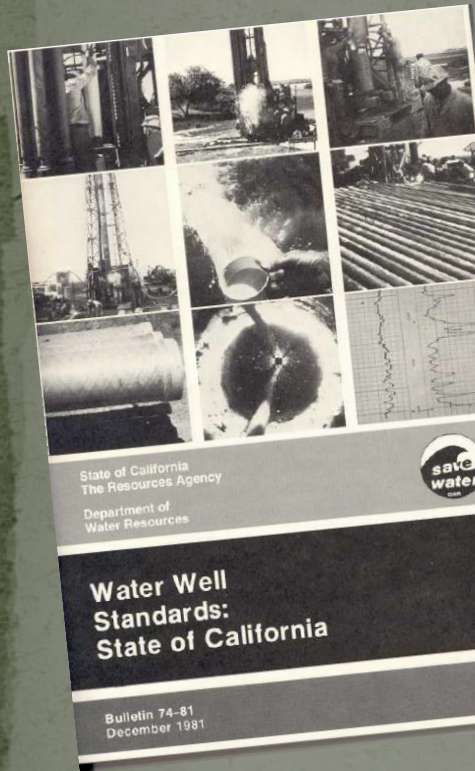
Meeting Agenda

- Background & History
- Project Scope
- Schedule
- Questions & Answers

History of Standards

- 1949 First directive to investigate and report
- 1967 Procedures for implementation
- 1968 Bulletin 74, Water Well Standards
- 1974 Bulletin 74-1, Cathodic Protection Well Standards
- 1981 Bulletin 74-81, Water Well Standards Update
- 1986 Implementation; Monitoring wells added
- 1991 Bulletin 74-90, Supplement
- 1996 GHEW added
- 1999 Draft GHEW Standards, April 1999
- 2010 CCDEH WWTAC Standards Subcommittee

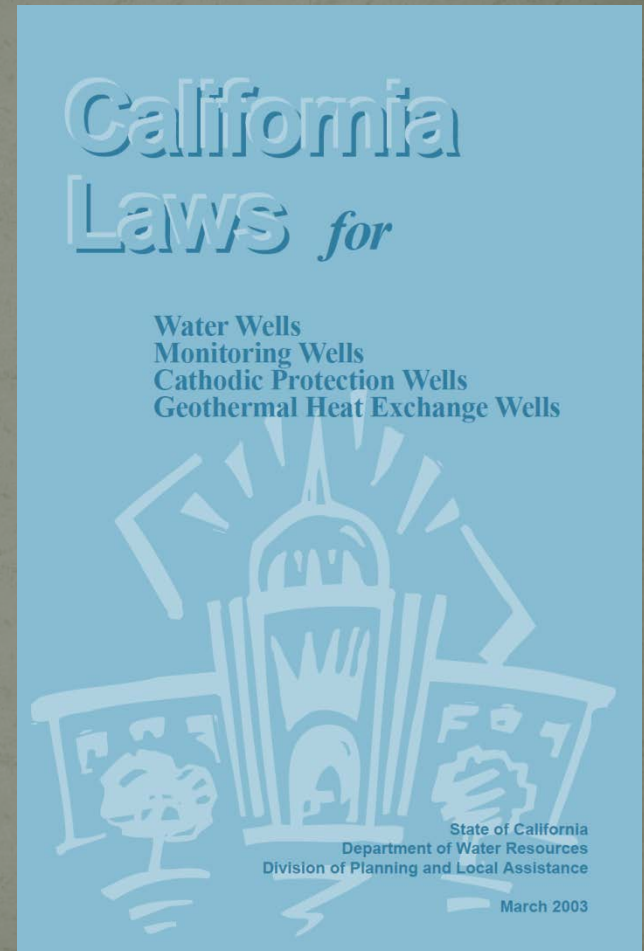
California Well Standards Documents



Statutory Responsibilities

Water Code §231 and 13800 et seq:

- DWR develops Standards
- DWR recommends to SWRCB
- SWRCB adopts Model Well Ordinance
- Cities, counties or water agencies adopt Local Well Ordinances
- Local Enforcing Agencies administer and enforce



Why Groundwater is Important

- Provides 25 - 40% of water supply during a normal year; more in a drought
- ~43% of Californians rely on GW as a drinking source
- Widely available
- In many areas there is no alternative
- Generally good quality, requires little treatment
- Limited resource

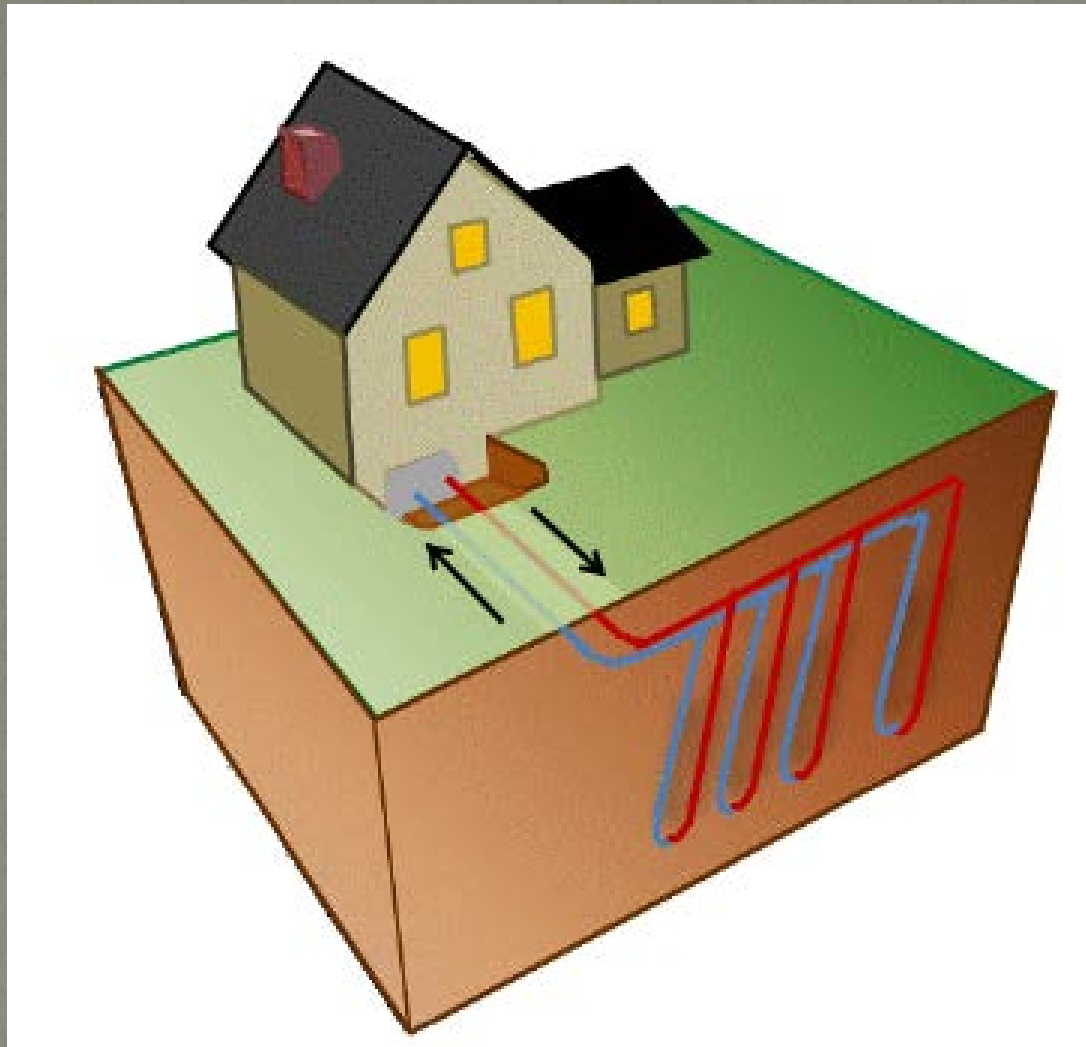
Standards Protect Groundwater

- Every boring is a potential conduit for contamination
- Remediation is expensive and can take a long time (100s – 1000s of years)
- Standards are written to prevent wells from becoming conduits for contamination
- Standards are a minimum for construction and destruction of wells to protect groundwater quality

Project Scope

1. Develop minimum standards for construction, maintenance, abandonment and destruction to protect groundwater quality
2. Water Code defines “Geothermal heat exchange well” as:
"Geothermal heat exchange well," as used in this chapter, means any uncased artificial excavation, by any method, that uses the heat exchange capacity of the earth for heating and cooling, in which excavation the ambient ground temperature is 30 degrees Celsius (86 degrees Fahrenheit) or less, and which excavation uses a closed loop fluid system to prevent the discharge or escape of its fluid into surrounding aquifers or other geologic formations. Geothermal heat exchange wells include ground source heat pump wells.
3. Open loop systems meet the definition of "water well," and Water Well Standards apply

Closed Loop Systems



Source: Ohio Water Resources Council

Closed Loop Systems

- Fluid circulated in a loop of pipe transfers heat from or to the ground, taking advantage of the earth's relatively constant temperature.
- Two basic types: Vertical, Horizontal
 - Vertical: Series, Parallel
 - Horizontal: Slinky, Ground, Pond

Closed Loop Systems

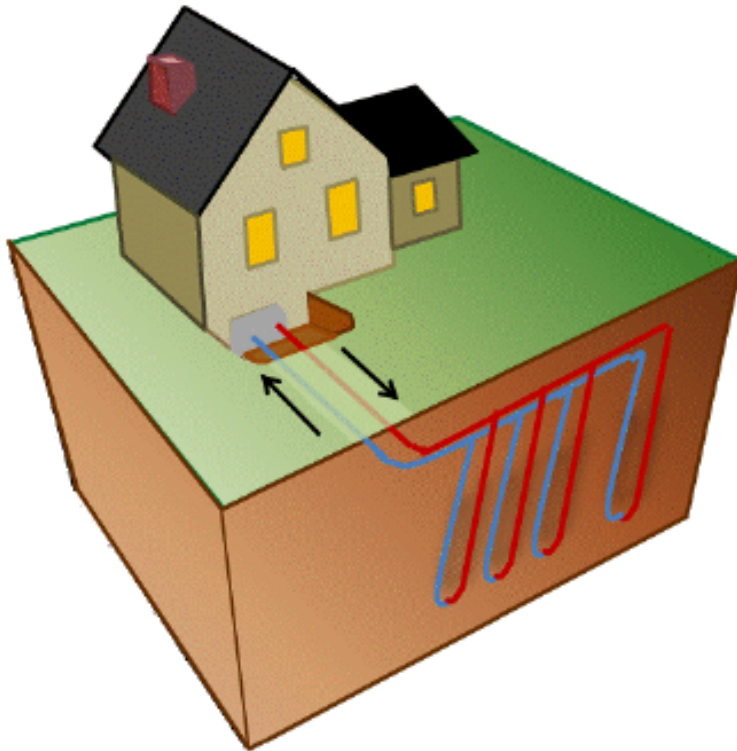


Figure 3 - A closed-loop geothermal heating and cooling system with vertical loops. Arrows indicate the flow direction in the summer, when the system removes heat from the building and transfers it into the earth. In winter, the flow direction is reversed and the system removes heat from the earth and transfers it into the building.

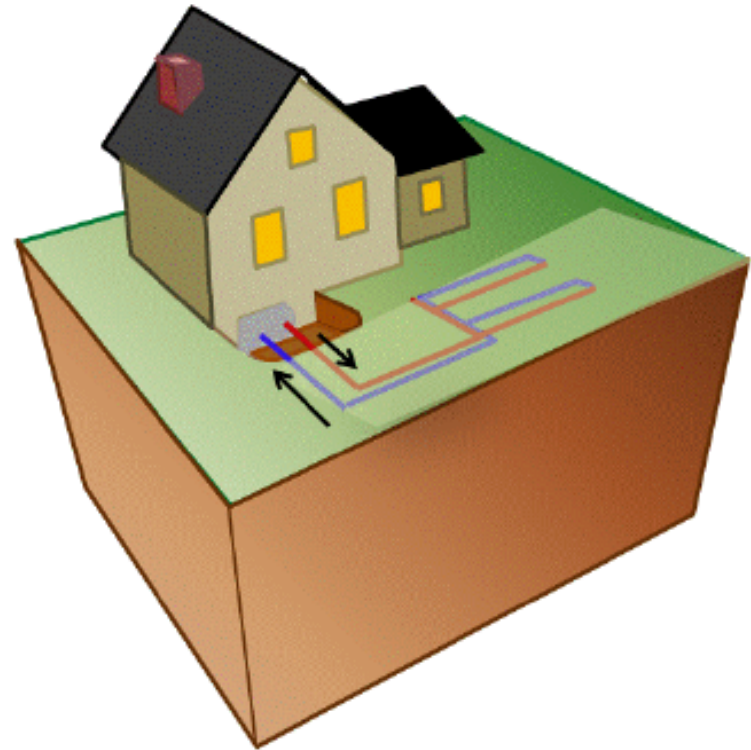


Figure 4 - A closed-loop geothermal heating and cooling system with horizontal loops. Arrows indicate the flow direction in the summer, when the system removes heat from the building and transfers it into the earth. In winter, the flow direction is reversed and the system removes heat from the earth and transfers it into the building.

VCL Design & Construction

- Simple in concept, complex in practice



VCL Design - Simplified

- Design parameters/constraints:
 - building loads
 - ground thermal characteristics
 - heat pump specifications
 - loop operating temperature range
 - field geometry
 - pipe characteristics
 - grout thermal characteristics
 - site and groundwater conditions

National Ground Water Association , Guidelines for the
Construction of Vertical Boreholes for Closed Loop Heat
Pump Systems

VCL Design - Simplified

- Test borehole(s) provide heat transfer properties of soil & locate groundwater
- Groundwater movement assists in heat diffusion

National Ground Water Association , Guidelines for the Construction of Vertical Boreholes for Closed Loop Heat Pump Systems

VCL Design - Simplified

- Loop field design specifications:
 - total length
 - loop piping diameter
 - borehole diameter
 - grout/fill materials
 - loop field layout/borehole spacing
 - individual borehole depth

National Ground Water Association , Guidelines for the
Construction of Vertical Boreholes for Closed Loop Heat
Pump Systems

VCL Construction - Simplified

- Test borehole(s) often used for loop
- Trench for headers
- Drill boreholes, install HDPE loops – weight and charge loops to counter buoyancy
- Connect loops to headers - heat fuse
- Up to 3 pressure tests of loops for leaks
- Grout: Typically full length, thermally conductive bentonite grout (>50% sand)
- Connect to Heat Pump
- Circulate Heat Transfer fluids – water or approved antifreeze (e.g. propylene glycol)
- Backfilling

Geothermal Projects in California

- By Lisa Meline, P.E.

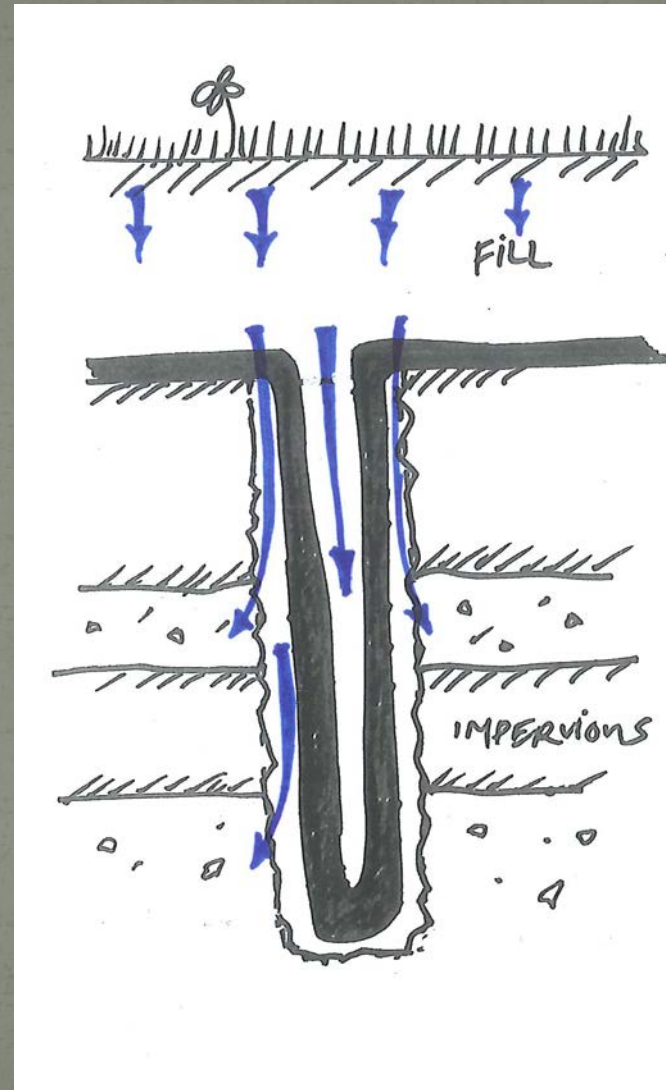
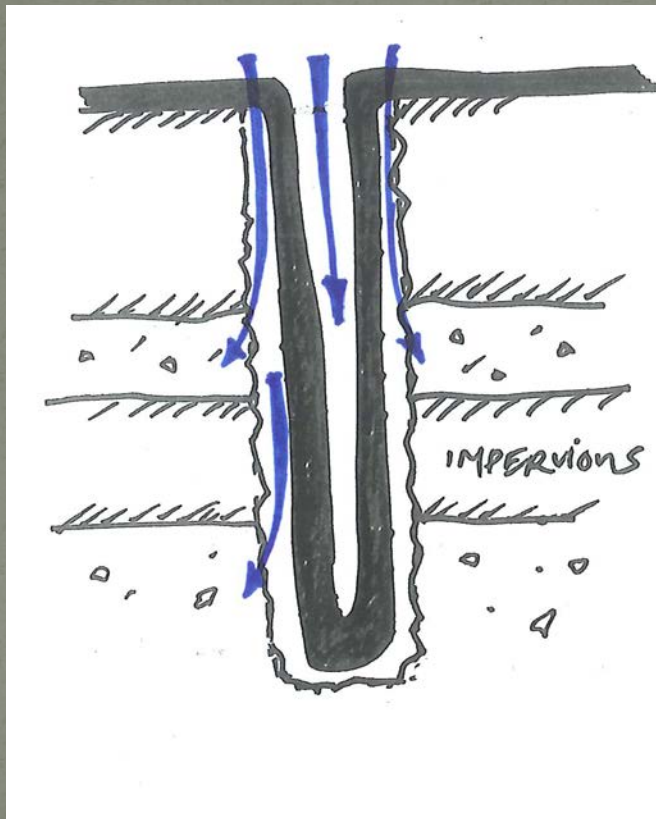
Green Technology

- “Geothermal closed loop heat pump systems using vertical boreholes are recognized as an efficient and environmentally friendly heating and cooling technology if installed and operated properly.” -Kansas standards
- USEPA 1993 report, “Space Conditioning: The Next Frontier,” found ground source heat pumps have lower energy consumption, CO₂ emissions, and environmental costs than most other space conditioning systems available.

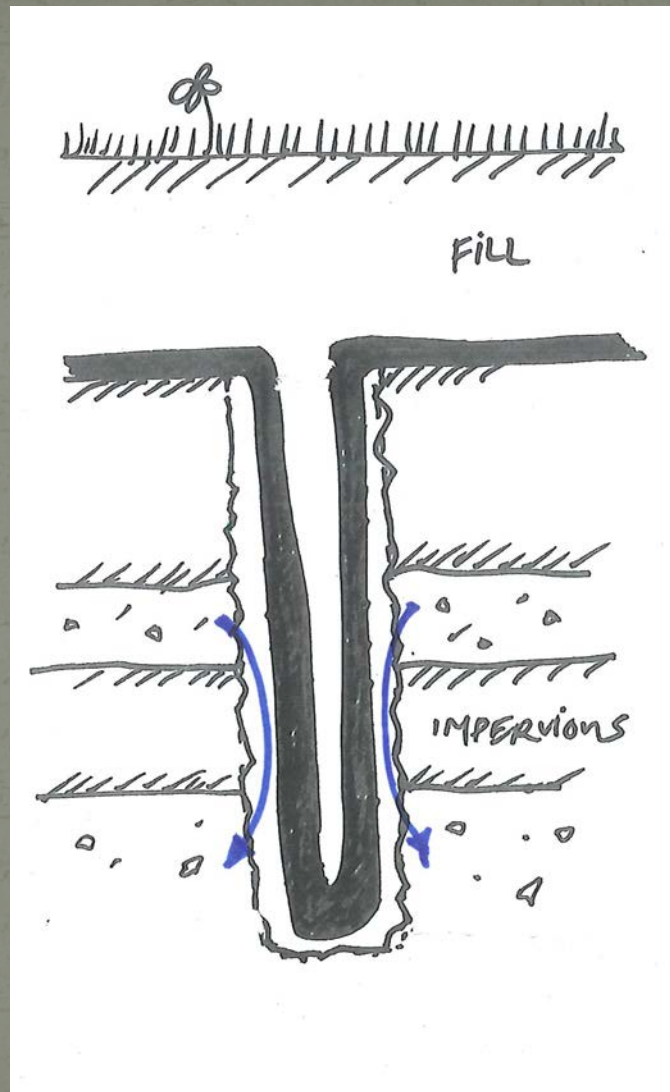
GHEW Standards Protect GW

1. Improper grouting/sealing between piping and borehole can provide a path for contaminated water to enter an aquifer –from surface or another aquifer

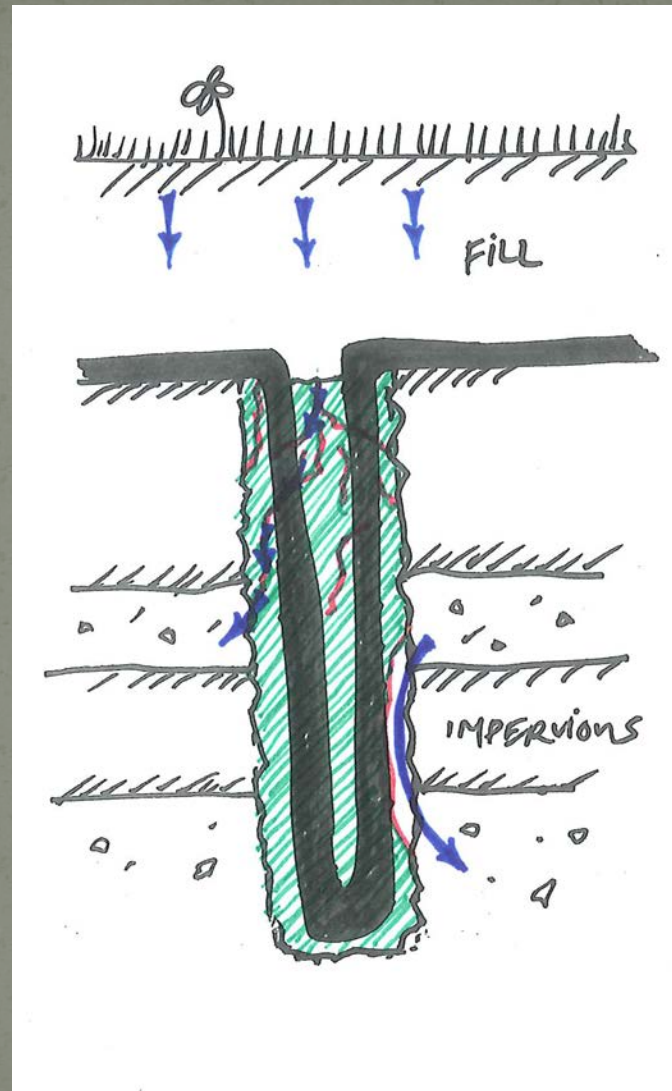
No seal – Surface contaminant



No seal – Adjacent aquifer



Ineffective seal



GHEW Standards Protect GW

2. Improper construction or destruction may release heat transfer fluid into the aquifer.
3. Identification in the field can prevent damage to loops, fluid leaks
4. Adequate setbacks can minimize impacts

Contents of GHEW Standards

- Location/Setbacks
- Driller Qualifications
- Reporting Requirements
- Definitions
- Borehole Diameter
- Sealing Materials & Placement
- Circulating Pipe/Loop Material & Connections
- Loop Fluids
- Pressure Testing
- Identification/marking
- Maintenance
- Destruction (Decommissioning)

Limitations of Standards

- DWR standards do not ensure proper function, sizing or efficiency of a GHEW system.
- DWR standards are not a manual for well construction or destruction.

Project Goals

- Primary focus of Update
 - Protect water quality
 - Current, relevant, technically correct, and in line with standard of practice
 - Final

Schedule

- Ongoing: Research – *WWTAC revisions, IGHSPA Standards, Nebraska Grout Study, Survey of State & Counties Standards*
- Winter: Revisions & Draft Update
- Early Spring: Issue Public Draft, 30-day comment period, two workshops
- Late Spring: Present to SWRCB

Contact Information

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